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Effect of Flipped Classroom and Think Pair Share Strategy on Achievement and Retention Among Senior Secondary School Physics Students

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Abstract

Recently, physics students' achievement and retention is deteriorating. To students, physics have a lot of abstract concepts and difficult to deal with. One of the reasons for this erroneous mindset is on the method in which teaching and learning of physics is done. Based on this, the study was necessitated, to determine the effect of flipped classroom and think pair share strategy on achievement and retention among senior secondary school physics students. 2×2 factorial research design was adopted. The population of the study comprised of all the 3965 senior secondary school two (SS2) physics students in 16 public schools in Onitsha-North Local Government of Anambra State, Nigeria. The sample size of the study comprised of 194 students of two intact classes or stream from a single senior secondary school drawn from the population using simple random sampling technique. The instrument for data collection was Physics Achievement Test (PAT) which consist of 20-items multiple choice questions of response opinion a, b, c & d. 0.77 reliability coefficient was established for PAT using test retest of temporal stability. All groups were pretested before the experiment and posttested after the experiment.

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PAT was reshuffled two weeks after the posttest to obtain students retention score. Mean and standard deviation was used in answering all the research questions while Analysis of Covariance (ANCOVA) was used to test all the null hypotheses. The result showed that flipped classroom is more superior in enhancing the achievement and retention of physics students. From the findings, it was recommended among others that state government in synergy with the school authorities should provide good flipped classroom facilities which will aid students' achievement and technological development to compete with the world at large.

Keywords: Achievement; Flipped Classroom; Think Pair Share Strategy; Retention.

1. Introduction

In recent time, the utilization of technology has permeated into different sectors of life due to the extent in which it provides simplicity towards task performance, deepen exchange and use of information in our everyday lives. The above statement can be seen as an undeniable importance of technology. Technology as the medium of everyday activities in modern societies [13]. These recent innovations via technology has been massively used by numerous people, particularly youths. For instance, in the use of laptops, projector, television, smart cell phones, DVD player, MP3/MP4, accessibility of internet and many more. The use of these gadgets can be educative, if channeled towards proper teaching and learning in senior secondary schools. Literature tells us that teaching and learning in most senior secondary schools is saddled with limited instructional materials or tools particularly interactive whiteboard [1] and power-point [36]; lack of laboratory demonstration [15,2]; and limited flipped classroom [21]. Though [3] discovered that flipped classroom as an instructional material, responds to the needs of modern learning and provides an effective model of reinvention since students prefer classroom experience that encourage and help them develop their knowledge. This is because, flipped classroom provides avenue for a topic to be viewed at home before the normal activity based on the same topic. Flipped classroom (FC) is also an instructional strategy due to its plain design to achieve a long term aim in teaching and learning process. This plain design was first developed and popularized by two chemistry teachers named Jonathan Bergman and Aaron Sams in the early mid-2000s at Colorado, in a struggle to find the time to re-teach lessons for absents students [35]. The flipped classroom design implies that the teacher provides the course content to the students through videos and other learning materials to be absorbed at their own time before they enter the classroom [11]. The instructor may also upload these materials online to be easily accessible to the student anyway and at any time [33]. Before uploading the online materials, the instructor should ensure the following; low stake problems or discussion questions based are included in the video; define the process of analyzing or solving such problem; think inclusively about the composition for small groups so that students can learn from a heterogeneous set of perspectives [28]. This means that flipped classroom promotes democratization of learning as autonomy of students' is enhanced, where the instructor is the guide. However, the students are encouraged to put down questions to ask once they come to class and not just to watch or read the instructional content [34]. Once the students come into the classroom, opportunity is given to them to voice out their opinion and share knowledge based on the instructional content through cooperative and collaborative activities [14]. However, different studies have been carried out in foreign countries to ascertain if flipped classroom effects or influences students' academic achievement in physics education. Some of these studies as revealed by [37,5,4,30] indicated that there is an enhancement on achievement scores of flipped classroom

students. Thus, the present study tends to determine whether flipped classroom and think pair share strategy has effect on students' achievement and retention in physics, in Nigeria. Also, the study tends to compare between think pair share strategy and flipped classroom so as to determine the strategy that is more effective since both involves cooperative discussion, collaborative method of teaching. And also, both strategy deals with students' centeredness and are used to help students form individual ideas. Think Pair Share Strategy (TPSS) just as the name appears, is a technique that involves engaging an individual into thinking activity and discussing ideas gotten from such thoughts. Reference [20] sees TPSS as an approach that provides students with adequate time to think in order to increase their quality of responses. In the same light [38] views TPSS as a strategy that includes three stepwise components, namely, time for thinking, time for sharing with a partner and time to share among pairs to a larger group. To this effect [18] added that TPSS requires students to; think individually about a topic or answer to a question; share ideas with classmates; and discussing such ideas with a partner that maximizes participation, focus attention and engage students in understanding the reading materials. Furthermore [18] also outlined the roles of instructor on using TPSS. They are as follow; decide upon the text to be read and develop the set of questions that targets key concepts; describe the purpose of the strategy and provide guideline for discussions; model the procedure to ensure that students understand how to use the strategy. This means that the TPSS supports students' centeredness since the instructor only provides guidelines for the students. On this end, question posed to students using TPSS approach must be consider alone by the student and then discuss with a neighbor before settling on a final answer. Based on this, the instructor can use the student responses as a basis for discussion, to motivate a lecture segment, and to obtain feedback about what students know or are thinking. However, with reference to several research studies on TPSS, it was observed that this strategy has significant effect on nursing students critical thinking style [20]; TPSS has effect on students' achievement in chemistry more than guided-discovery method [6]; TPSS has no significant effect on academic achievement of undergraduate students in educational psychology when compared with co op-co op and traditional learning strategies [7]; TSPP plays an important positive role in improving students oral communication skills [29]. From the above reviewed literature, it can be deduced that much study has not been carried out with the use of TPSS in science education (specifically physics). Also, the reviewed literature did not indicate the use of flipped classroom and TPSS on students' achievement and retention. Furthermore, it is still inconclusive whether TPSS has significant effect on students' academic achievement. Thus, there comes the need to determine the effect of flipped classroom and TPSS on students' achievement and retention in senior secondary school physics. Students' achievement is the ability of a learner to be successful in a performed task. The outcome of task performed by a student have to improve in order to ensure success in school and lifetime before the student is said to have achieved what he/she ought to achieve. This is in-line with the view of [17] that, student achievement is the result of what a student has learned from some educational experiences. The result of students' achievement via educational experience could be obtained by quality and quantity of students work usually indicated by grade point average, test scores and degree [8]. However, the achievement of physics students in their end of the term examination has been on the decline from 2015-2017 as evident in Post Primary School Service Commission (PPSCO), particularly in Onitsha-North LGA of Anambra State which is the researchers' area of study. From 2015, 2016 and 2017 results, it was shown that, 45.03%, 41.23%, and 39.45% of the students respectively had credits in physics. This could be attributed to inability of physics teachers in using the right or effective teaching method which enhances students' achievement and retention as opined by

[26]. However, achievement according to [9] is a function of retention. This implies that students' ability to remember have the tendency of improving that student achievement. To this end, effective teaching strategy could improve retention. Retention in this study is an act possess by a physics student in remembering a task or material learnt. This also means that for a physics student to retain; the task has been absorbed and the experiences gotten from such task is continuously held, and also used. To [32], retention is seen as a vital component in learning process particularly in physics where application of acquired ideas and construction of ideas are needed to solve new problems. However, some of the reviewed literature pointed out different view held by science educators on students' retention in sciences. Some of these views includes; students' retention depends on the appropriateness of the teaching method [39]; retention has no significant interaction effect with gender and instructional materials [27]; there was significant effect of flipped classroom on students' retention in chemistry [31]; two equivalent pedagogical approach has significant effect on students' retention in favor of interactive engagement method [12]. From the foregoing, it obvious that none of the studies was done using physics students. Also, we cannot deduce from the above studies if a particular teaching method has effect on students' retention specifically in physics. Based on this problems, the researchers need to investigate the present study. Thus, the specific purposes of the study are; to determine the mean achievement ratings of students taught using flipped classroom; and to find out the mean retention ratings of students taught using flipped classroom and those taught using think pair share strategy?

The following research questions guided the study;

a) What are the mean achievement score of students taught using flipped classroom and those taught using think pair share strategy?
b) What are the mean retention score of students taught using flipped classroom and those taught using think pair share strategy?

The following null hypotheses were formulated and tested at 0.05 level of significance to guide the study.

a) Mean achievement score of students taught using flipped classroom and those taught using think pair share strategy is not statistically significant.
b) Mean retention score of students taught using flipped classroom and those taught using think pair share strategy is not statistically significant.

2. Methods

The study adopted 2×2 factorial research design. The population of the study comprised of all the 3965 SS2 physics students in 16 public schools in Onitsha-North Local Government Area (LGA) of Anambra State. This LGA was chosen since schools here benefited from the state government intervention in equipping computer rooms and laboratories [25]. The sample size of the study comprised of 194 students of two intact classes or stream from a single senior secondary school. The sample size was drawn from the population using simple random sampling technique. The instrument for data collection was Physics Achievement Test (PAT). PAT consist of 20-items multiple choice questions of response opinion a, b, c & d. PAT was developed by the

researcher using test-blue print or table of specification to ensure proper content coverage. PAT was face validated by three experts from the department of science education in the faculty of Education, University of Nigeria, Nsukka. Content validity of PAT was determined using table of specification. The reliability of the instrument was determined by administering the instrument to 30 SS2 physics students in Ogbaru Local Government of Anambra State who are not part of the study but share the same characteristics with the students under investigation. 0.77 reliability coefficient was established for PAT using test retest of temporal stability. This is because the study focuses on retention which involves pretesting and post-testing using the same instrument.

2.1 Treatment Procedure

Before the commencement of the experiment, PAT was administered to two intact classes (FC and TPSS) for pretesting, so as ascertain the initial knowledge of the students on physics curricular contents. The pretest was done during the normal school period to make sure that all the students are present. After the pretest, the actual experiment commenced with one-week training of Physics teachers of the sampled school as research assistants on the two methods (i.e. FC and TPSS). This was done to control teachers variable; that is error(s) that might arise as a result of teacher difference on students' achievement and retention. Four Physics teachers in the sampled schools were trained and used for the study. During the training, the teachers were provided with four validated lesson notes on the use of the two methods. Posttest was administered three weeks after the experimental treatment. The posttest was administered to both groups at the same time. The pretest and posttest lasted for 40 minutes. PAT was reshuffled two weeks after the posttest to obtain students retention score. A total of six weeks was taken for the study, this is to minimize the effects of maturation and history on students used for the study. Mean and standard deviation was used in answering all the research questions while Analysis of Covariance (ANCOVA) was used to test all the null hypotheses at 0.05 level of significance.

3. Results

Research Question 1: What are the mean achievement score of students taught using flipped classroom and those taught using think pair share strategies?

Table 1: Mean achievement score and standard deviation of students taught using flipped classroom and those taught using think pair share strategies

Method	N	Pretest Mean	Std. Dev.	Posttest Mean	Std. Dev.	Mean Gain
Flipped Classroom (FC)	95	19.80	1.900	22.41	1.704	2.61
Think Pair Share Strategy (TPSS)	99	16.43	2.352	18.29	2.186	1.86

The result in **table1** showed that before treatment; FC had mean rating and standard deviation of ($\bar{x}$ = 19.80, SD = 1.900). However, after treatment; FC had mean rating and standard deviation of ($\bar{x}$ = 22.41, SD = 1.704). For

TPSS, the mean rating and standard deviation before treatment were ($\bar{x}$ = 16.43, SD = 2.352) while ($\bar{x}$ = 18.29, SD = 2.186) mean rating and standard deviation for TPSS were obtained after treatment. However, the difference in mean (or mean gain) of FC and TPSS were 2.61 and 1.86 respectively. This indicates that students taught using flipped classroom achieved more than those taught with TPSS as judged by their respective posttest mean and mean gain. This means that teaching physics with the use of flipped classroom enhanced students' achievement. This was further strengthened by the supportive null hypothesis (i.e. H_{O1}).

H_{O1}: Mean achievement score of students taught using flipped classroom and those taught using think pair share strategies is not statistically significant.

Table 2: ANCOVA of achievement mean score of students taught using flipped classroom and those taught using think pair share strategies

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared (η^2_p)
Corrected Model	1089.013[a]	2	544.506	219.212	.000	.697
Intercept	285.400	1	285.400	114.898	.000	.376
Achievement Pretest	267.064	1	267.064	107.517	.000	.360
Method	153.256	1	153.256	61.699	.000	.244
Error	474.431	191	2.484			
Total	81582.000	194				
Corrected Total	1563.443	193				

a. R Squared = .697 (Adjusted R Squared = .693)

As presented in **table2**, the result showed that an f-ratio of ($F(1, 193) = 61.699$, $p < .05$, $\eta^2_p = .244$) was obtained. Since the associated probability value of 0.00 is less than 0.05 set as level of significance, the null hypothesis was rejected. Thus, inference drawn is that the difference in the mean achievement score of students taught with flipped classroom and those taught with think pair share strategy is significant. This shows that teaching Physics using flipped classroom proved to be more effective in enhancing students' achievement. The result further showed the effect size of ($\eta^2_p = .244$), which indicates that 24.4 percent variance in students' achievement in Physics can be explained by the method used.

Research Question 2: What are the mean retention score of students taught using flipped classroom and those taught using think pair share strategy?

The result in **table3** showed that before treatment; FC had mean score and standard deviation of ($\bar{x}$ = 12.80, SD = 1.661). However, after treatment; FC had mean rating and standard deviation of ($\bar{x}$ = 15.68, SD = 1.522). For TPSS, the mean score and standard deviation before treatment were ($\bar{x}$ = 10.44, SD = 1.581) while ($\bar{x}$ = 12.53, SD = 2.022) mean score and standard deviation for TPSS were obtained after treatment. However, the difference in mean (or mean gain) of FC and TPSS were 2.88 and 2.09 respectively. This indicates that students

taught using flipped classroom retained more than those taught with TPSS as judged by their respective posttest mean and mean gain. This means that teaching physics with the use of flipped classroom would enhance students' retention in physics. This was further strengthened by the supportive null hypothesis (ie. HO_2).

Table 3: Mean retention score and standard deviation of students taught using flipped classroom and those taught using think pair share strategies

Method	N	Pretest Mean	Std. Dev.	Posttest Mean	Std. Dev.	Mean Gain
Flipped Classroom (FC)	95	12.80	1.661	15.68	1.552	2.88
Think Pair Share Strategy (TPSS)	99	10.44	1.581	12.53	2.022	2.09

H_{O2}: Mean retention score of students taught using flipped classroom and those taught using think pair share strategies is not statistically significant.

Table 4: ANCOVA of retention mean ratings of students taught using flipped classroom and those taught using think pair share strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared($\eta^2_{p)}$
Corrected Model	527.763[a]	2	263.881	86.418	.000	.475
Intercept	457.006	1	457.006	149.664	.000	.439
Retention Pretest	43.986	1	43.986	14.405	.000	.070
Method	122.233	1	122.233	40.030	.000	.173
Error	583.227	191	3.054			
Total	39528.000	194				
Corrected Total	1110.990	193				

a. R Squared = .475 (Adjusted R Squared = .470)

Table4 showed an f-ratio result of ($F(1, 193) = 43.986$, $p < .05$, $\eta^2_p = .070$) was obtained. This led to rejecting the null hypothesis. Therefore, it is concluded that there is significant difference in the mean retention ratings of students taught using flipped classroom and those taught using think pair share strategy in favor of FC. However, partial eta square of 0.173 indicated that 17.3% of achievement test is attributed to the method.

4. Discussion

The findings of this study showed that students taught using flipped classroom achieved higher than those taught with TPSS. Additional analysis showed that the mean achievement score of students taught with flipped classroom and those taught with think pair share strategy is significant, in favor of those taught with FC. The result of this study may not be far from the fact that students using flipped classroom understands the practical aspect of such concept more by viewing the video clip than their counterpart who only share knowledge based

on abstract understanding. This is in alignment with the findings [24] that there is significant improvement on semester grades of students when taught using flipped classroom strategy. Also, the finding of this study is in consonance with that of [36] who reported that flipped classroom instructional technology was effective in enhancing the achievement of physics students at both post-test and follow-up measurements. Reference [15] investigation on the effect of a flipped classroom on students' achievements, academic engagement and satisfaction level supports the finding of this study. Reference [15] unveiled that the scores of students in the experimental group (flipped classroom) with regard to achievement and engagement were higher than the scores for those in the control group and the difference between the groups were statistically significant. However [19] report contradicts with the finding of the present study. The report showcased that students taught computer application using flipped classroom have low mean achievement rating. Also result in this study revealed that students exposed to senior secondary school physics using FC retained higher than those taught with TPSS. This was further strengthened by the supportive null hypothesis; that there is significant difference in the mean retention ratings of students taught using FC and those taught using think pair share strategy in favor of FC. This outcome could be because, students in FC group who have seen the video clip of the concept could figure out any question ask through imagination of the seen clip. This is in-line with the findings of [31] who researched on impact of the flipped classroom on students' performance and retention. It was observed that there was significant effect of flipped classroom on students' retention in chemistry. The result of this study is in alignment with the finding of [23] who observed that the use of FC improved students' retention in mathematics and also enhanced their performance. Reference [21] finding is also in agreement with the finding of this study. It was revealed by [21] that students taught with flipped anatomy classroom had a higher retention than those taught without flipped anatomy classroom. Also, the result of this study agrees with that of [10] that there is significant difference in retention of students taught using FC than those taught with conventional method.

5. Conclusion

This study sought to find out the effect of flipped classroom and think pair share strategy on achievement and retention among senior secondary school physics student. The result showed that flipped classroom is more superior in enhancing the achievement and retention of physics students. Hence, students taught with flipped classroom achieved and retained better than those taught with think pair share strategy.

6. Recommendations

In light of the findings of this study, the researchers made the following recommendation;

1. In view of the fact that flipped classroom as a modern technology is more superior in enhancing the achievement and retention of physics students. Physics teachers should be trained so as to be well equipped with the require acquaintance on the use of flipped classroom for content delivery of the classroom lessons.
2. Good flipped classroom should be made available in secondary schools by the state government in collaboration with the school authorities since it aids students' achievement and by extension the technological development of the students so as to compete with the world at large.

7. Limitations of the Study

This study has efficiently summarized the effect of flipped classroom and think pair share strategy on achievement and retention among senior secondary school physics students. This study, however is not without its limitations. Since different research assistants were used for the two groups, it could be assumed that they might not have been of equal attributes in terms of cognition and affective functioning. This might have introduced teacher bias. We hope that future researchers would replicate the study with a larger population, in different geographical and subject areas.

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APPENDIX

Physics Achievement Test (PAT)

Instruction: Please tick [√] against the option that corresponds with your choice of answer in the items below.

Time: 50 minutes

1. Which of the following is a vector?

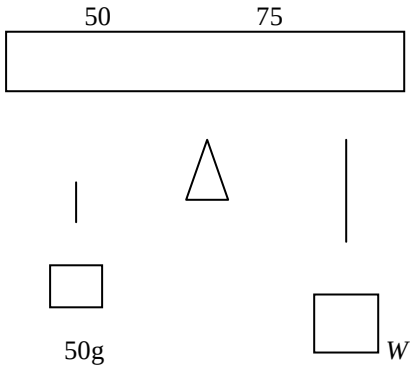
a. Speed
b. Mass
c. Time

d. Weight

2. A tennis ball is projected with a velocity of $3ms^{-1}$ at an angle of 30^o to the horizontal, calculate the time of flight in seconds. (take $g=9.8ms^{-2}$).

a. 5.2 b. 2.6 c. 0.3 d. 0.15

10



3. With reference to the diagram above, find the value of *W*.

a. 80g b. 50g c. 40g d. 20g

4. The relative density of ice is 0.92. What fraction of the volume of a piece of ice will be submerged when floating in a liquid of relative density 1.11?

a. 27% b. 40% c. 83% d. 93%

5. The pressure at a point in a liquid depends on

a. Density of the liquid

b. Density and depth of the liquid only

c. Area and density of liquid

d. The depth of liquid only

6. A hydraulic press works on the principle of transmission of

a. force b. energy c. volume d. pressure

7. when a body is performing simple harmonic motion, its acceleration

a. is constant

b. varies with displacement from equilibrium positions

c. is zero

d. moves irregularly with time

8. What is the angular speed (in $rads^{-1}$) of a body whose frequency is 50Hz?

a. 200π b. 100π c. 50π d. 10π

9. The property of a body to remain at rest or to continue to move in a straight line, is known as

a. Force b. Impulse c. momentum d. inertia

10. For elastic solution,

a. Energy is doubled and momentum is halved

b. Energy is conserved

c. Momentum is conserved

d. Kinetic energy and momentum are conserved

11. When a simple harmonic motion is affected by severe air resistance, the motion is said to be

a. damped b. forced motion c. natural d. motion sinusoidal

12. Which of the following is a scalar?

a. displacement b. acceleration c. time d. velocity

13. The heat supplied to increase the temperature of a liquid of mass 10kg by 40oc is 200j. Calculate the heat capacity of the substance. (hint: $H=mc\Delta\theta$)

a. $10.5jkg^{-1}$ b. $5.0jkg^{-1}$ c. $150jkg^{-1}$ d. $0.5jkg^{-1}$

14. What is the potential difference across a system when a current of 2A is allowed into the system for 5 seconds it the heat supplied to the system is 500j? (Hint: H= ivt)

a. 5volts b. 10 volts c. 50 volts d. 100volts

15. A vector of magnitude 3 units in the north direction is combined with another vector to give a zero resultant, the other vectors is?

a. I5 units in North direction

b. 5 units in East direction

c. 3 units in South direction

d. 10 units in the West direction

16. Center of gravity is define as

a. A point acting in between two equal but opposite force

b. The point through which the resultant weight of the body acts

c. the magnitude of object placed at the edge of an object

d. the perpendicular distance from the middle point to the line of action

17. Moment of force about a point can be defined as

a. the product of the force and the perpendicular distance from the point to the line of action of the force

b. the point at which force turns an object at the moment

c. A point acting in between two equal but opposite force

d. The point through which the resultant weight of the body acts

18. The acceleration of a body undergoing a uniform circular motion is given by

a. $\omega^2 x$ b. ωxr c. ωr^2 d. ω/r

19. A body of mass 40kg is given an acceleration of $10ms^{-2}$ on a horizontal ground for which $\mu = 0.5$. Calculate the force required to accelerate the body (take $g=10ms^{-2}$).

a. 6.00N b. 60.0N c. 6.50N d. 600N

20. Which of the following is not correct? Simple example of first order levers are:

a. Crowbar b. claw hammer c. plier d. wheel barrow